(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 570 215 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **93303692.3**

(51) Int. Cl.[5] : **B32B 7/14**

(22) Date of filing : **12.05.93**

(30) Priority : **13.05.92 GB 9210229**

(43) Date of publication of application : **18.11.93 Bulletin 93/46**

(84) Designated Contracting States : **AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE**

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(54) Improvements in and relating to liquid impermeable and liquid vapour permeable laminates.

(57) A laminate (10) comprises : a liquid impermeable and liquid vapour permeable film (12) ; and a supporting substrate (14, 18), the film and substrate being intermittently bonded to (16, 20) to preserve the liquid vapour transmission properties of the film (12).

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This invention relates to a liquid impermeable and liquid vapour permeable laminate, and a method of forming such a laminate.

Various films of coextruded or monolayer construction are available which, by virtue of a plurality of micropores or by molecular diffusion mechanisms, have the characteristics of providing a barrier to, for example, aqueous liquids while at the same time allowing the passage of moisture vapour. A microporous membrane having such properties is made by Exxon Corporation under the trade name "Exxaire" and is a polyolefinic membrane with excellent vapour transport characteristics. However, such membranes typically possess inadequate tensile strength properties and low resistance to tear for unsupported use and in many applications require to be combined with other materials to improve these properties.

It is an object of the present invention to provide a laminate incorporating such a film.

It is an object of a further aspect of the present invention to provide a laminate incorporating such a film in which the film forms the inner layer in a combination of three or more layers.

According to the present invention there is provided a laminate comprising a liquid impermeable and liquid vapour permeable film and a substrate, the film and substrate being intermittently bonded to preserve substantially the liquid vapour transmission properties of the film and the flexibility of the laminate.

According to a further aspect of the present invention there is provided a method of forming a laminate comprising intermittently bonding a liquid impermeable and liquid vapour permeable film to a substrate, the intermittent bonding preserving the vapour transmission properties of the film and the flexibility of the laminate

Most preferably, a supporting substrate is provided on both sides of the film.

Preferably also, the laminate includes a woven fabric, which may be in the form of a scrim, intermittently bonded to one of the other laminate components. Most preferably, the fabric is bonded to the film.

Preferably, one of the the substrates is a spunbonded polymeric non-woven material. Methods of producing such materials are described, for example, in UK Patents Nos. 203,763, 203,764, 203,765 and 204,071. The substrate may be formed as a web and may be formed over a wide range of weights typically, but not exclusively, from 10 g/m^2 to 200 g/m^2. Preferably the webs are of weight from 30 g/m^2 to 90 g/m^2. For certain applications it may be desirable to impart particular characteristics, such as flame retardancy, hydrophobicity and anti-static properties, to the spunbond web by addition to the polymer melt from which the web is formed or by subsequent application of appropriate coatings.

The preferred form of substrate provides a significant contribution to the desirable strength and stability properties of the laminate and provides protection against mechanical damage to the film.

The film is preferably of coextruded or monolayer construction having a plurality of micropores or providing a molecular diffusion mechanism to provide the barrier to liquid while allowing the passage of liquid vapour.

In the preferred laminate incorporating a woven fabric layer, the fabric preferably provides the laminate with very high tensile strengths and resistance to tear as well as dimensional stability. Preferably the woven fabric is based upon woven polyolefinic tapes, such as polypropylene. Where it is desirable to impart a high degree of dimensional stability woven materials incorporating bicomponent tape are particularly effective, an example of such a material being manufactured by the applicants under the Bondweave trade mark.

These woven fabrics are composed of coextruded, bicomponent tapes having a propylene homopolymer core with propylene copolymer surface. The copolymer softens at a temperature say in the range 100 - 130°C so that it can be thermally bonded to the vapour permeable film by selection of the appropriate copolymer without affecting the strength of the woven scrim substrate. Furthermore, the softening point of the copolymer can be selected so that it bonds to the film causing minimal disruption to the structure of the film.

Alternatively, the layers of the laminate may be bonded together by means of an adhesive applied in a discontinuous manner. This may be accomplished by, for example, gravure or rotary screen adhesive application, adhesive jet application, spray applications such as hot melt spray or any of the relevant techniques whereby adhesives may be applied in a manner which gives an adequate control of the percentage of bonded area to be achieved. Such adhesive bonding is particularly useful when bonding sheets of chemically and physically dissimilar materials.

Most preferably, the component sheets of the laminate are thermally bonded. Thermal bonding may be achieved using a combination of heat and pressure and an intermittent bond pattern. The bonded area is preferably 5% to 50% of the surface area of the laminated layers, and most preferably 14% to 20% of the surface area. The temperature and pressures selected for the bonding process are chosen to ensure an adequate thermal bond between the different sheet materials whilst minimising any adverse physical effects to the components. This is particularly important with respect to the film layer where inappropriate lamination conditions may result in an unacceptable amount of "pin-holing" with a consequent reduction in barrier properties.

With thermal bonding, the achievement of an

adequate and permanent bonding between the different layers requires that the materials are compatible, that is the materials should have broadly similar softening temperatures and be sufficiently chemically compatible such that autogenous bonding occurs under conditions of appropriate heat and pressure.

Thermally bonded laminates have identifiable inherent advantages when compared to equivalent adhesively bonded structures, including: flexibility in processing in that the thermal bonding may be conducted off-line, or in-line where lamination is achieved simultaneously with the formation of the other layers and the preferred fabric layer; more even weight distribution across the laminate; higher strength to weight ratios due to absence of an adhesive layer; improved flexibility; the products are free from odours or pH variation which may occur due to the presence of adhesive; better control of bonded area; and the products are more easily recycled as the thermally bonded structure would preferably consist of polymer or polymer blends of a similar type, for example 100% polyolefin.

It is a desired objective of the preferred embodiment of the invention to provide as high a moisture or liquid vapour permeability as possible in the finished laminate, compared to that of the unlaminated film. Surprisingly, it has been found that the moisture vapour permeability is not suppressed to the degree expected by the above techniques. It would be expected, for example, that thermal bonding would eliminate the complex structure of micropores in the area of the thermal bond with a subsequent reduction in the ability to transport moisture vapour in that area. However, it has been found that while there is an observed reduction in the moisture vapour permeability this is not in proportion to the bonded area.

In one example, tests of moisture vapour permeability to ASTM F903 gave figures of 8000 g/m^2/24 hr for an unsupported microporous film and 7500 g/m^2/24 hr for the same film thermally laminated to a spunbonded non-woven fabric with a 19% bonding area. In a second example, a two component thermal laminate under an alternative test method (BS3177) had a moisture vapour permeability of 1780 g/m^2/24 hr whereas a similar structure combined adhesively with a further spunbonded non-woven fabric layer, had a moisture vapour permeability of 1687 g/m^2/24 hr, indicating a reduction of only approximately 5% in moisture vapour permeability with a bonding area and hence an apparent reduction in open area of greater than 20%.

Thus, utilising the present invention it has been found possible to form composite structures with a high degree of bonding between the component layers of a laminate while maintaining a surprising level of moisture vapour permeability. This of particular benefit where the strength and the physical stability of the composite structure under a wide range of conditions are of importance, for example in roofing underlay applications. Roofing underlays are ideally strong, that is possess good tensile strength, burst strength and nail tear properties, are waterproof, are adequately physically stable over an extended period of time (minimum 10 years) and capable of maintaining these properties over a wide temperature range, from sub zero to 80°C. Moisture vapour permeability is an added advantage in helping to obviate the risk of condensation in the roof structure.

These aspects of the present invention will now be described, by way of example, with reference to the accompanying drawing which shows a somewhat schematic cross-section of a laminate in accordance with an embodiment of the present invention.

The illustrated composite or laminate 10 comprises a microporous membrane 12 of 23 g/m^2 basis weight, bonded to a UV stabilised spunbonded non-woven fabric 14 of 80 g/m^2 basis weight by thermal bonding using an intermittent diamond pattern emboss pattern 16 with an embossed area of 19%. These components 12, 14 are further laminated to a woven UV stabilised polypropylene fabric 18 by an intermittent adhesive bonding technique such that the microporous membrane 12 forms the inner layer between the two fabric layers 14, 18. The adhesive is indicated by reference numeral 20.

In this structure the spunbonded fabric layer 14 may conveniently be formed simultaneously with the thermal lamination of the layer 14 to the film 12 and acts to provide mechanical protection for the film 12, while the main strength and stability characteristics of the composite 10 are provided by the woven fabric 18.

Claims

1. A laminate (10) comprising: a liquid impermeable and liquid vapour permeable film (12); and a substrate (14), the film and substrate being intermittently bonded (16) to preserve the liquid vapour transmission properties of the film.

2. The laminate of claim 1 wherein a supporting substrate (14, 18) is provided on both sides of the film, the film and the substrates being intermittently bonded (16, 20) to preserve the liquid vapour transmission properties of the film

3. The laminate of claim 1 or claim 2 including a woven fabric layer (18).

4. The laminate of claim 3 wherein the woven fabric is in the form of a scrim, intermittently bonded to one of the other laminate components.

5. The laminate of claim 3 or 4 wherein the woven

fabric (18) is bonded to the film (12).

6. The laminate of any one of the preceding claims wherein one or both of the substrates is a spunbonded polymeric non-woven material (14).

7. The laminate of claim 6 wherein the spunbonded non woven substrate (14) is formed as a web to be subsequently calender bonded simultaneously with thermal lamination to the film (12).

8. The laminate of claim 7 wherein the web (14) is of a weight of between 10 g/m^2 and 200 g/m^2.

9. The laminate of claim 8 wherein the web (14) is of a weight of between 30 g/m^2 and 90 g/m^2.

10. The laminate of any of the preceding claims wherein the film (12) is of monolayer construction.

11. The laminate of any one of the preceding claims incorporating a woven fabric substrate (18) formed of woven polyolefinic tapes.

12. The laminate of claim 11 wherein the woven fabric (18) is formed of bicomponent tapes.

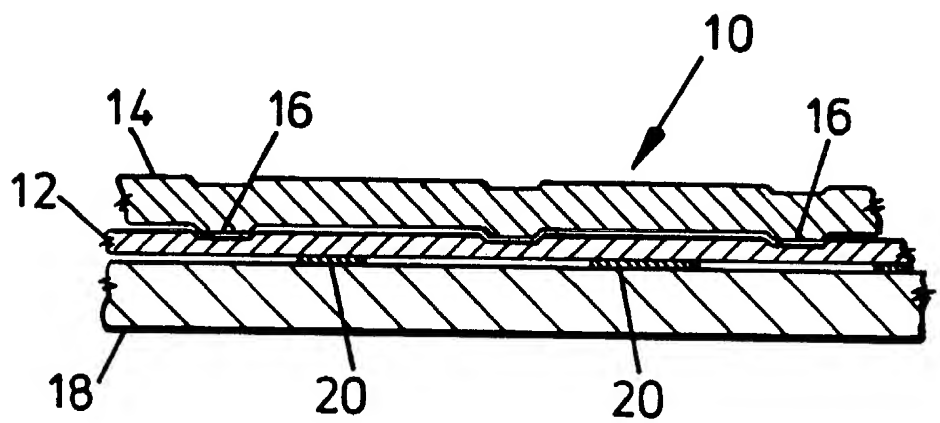
13. The laminate of any of the preceding claims wherein the layers of the laminate are bonded together by means of an adhesive applied in a discontinuous manner.

14. The laminate of any one of claims 1 to 12 wherein the layers of the laminate (12, 14, 18) are thermally bonded.

15. The laminate of any of the preceding claims wherein the bonded area (16, 20) forms between 5% and 50% of the surface area of the laminated layers (12, 14, 18).

16. The laminate of claim 15 wherein the bonded area (16, 20) forms between 14% and 20% of the surface area of the laminated layers (12, 14, 18).

17. A method of forming a laminate comprising intermittently bonding a liquid impermeable and liquid vapour permeable film to a substrate, the intermittent bonding carried out so as to preserve substantially the vapour transmission properties of the film.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